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Effect of Plasticizer and Chitosan Composition on the Plastic Biodegradable Quality from Starch Cassava Rubber (Manihot Glaziovii) as Alternative Plastic

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ABSTRACT

The rapid increase in urban population in palembang city be accompanied with the waste plastic problem who estimated 14,5 % plastic waste dominate river and soil. The biodegradable plastic is one solution to overcome the problem of environmental pollution. Plastic Biodegradable is a natural polymer that is easily decomposed by microorganisms. Starch is a polymer that can be used for bio plastic because it is easily updated, and abundant source, for example, a rubber cassava starch (Manihot Glaziovii). This study aimed to determine the effect plasticizers and chitosan composition of the characteristics of biodegradable plastics and obtain optimum composition. Manufacture of biodegradable plastics is done in three stages, manufacture of cassava starch rubber, the manufacture of biodegradable plastics with the addition of sorbitol, glycerol, chitosan composition variation of 50% by weight of starch that is 5 grams, and physical properties of edible film includes tensile strength, percent elongation, and biodegradation testing. Results obtained is the form of a thin sheet of plastic biodegradable tested mechanical properties. The addition of plasticizers with high levels produces biodegradable plastics with low tensile strength values, and the high percent of flexibility. While the addition of chitosan with high levels produces the opposite results. The results showed that the biodegradable plastic obtained the best results by a tensile strength that is on the composition of 0% Sorbitol + 0% Glycerol + 50% Chitosan is 0.00980 MPa. While based on the percent elongation of the best results that the composition 20% Sorbitol + 15% Glycerol + 15% Chitosan is 3 %, and all of the resulting plastic degraded completely less than 60 days, the media plastic waste water more quickly degraded. The biodegradable plastic is one solution to plastic waste problem of environmental pollution. Plastic Biodegradable is a natural polymer that is easily decomposed by microorganisms and Biodegradable plastic can be answered one of environment problem in palembang city about plastic waste.

Keywords: Bioplastics, Cassava rubber starch, Chitosan, Tensile strength, Biodegradable

I. INTRODUCTION

Approximately 20% of palembang waste volume is plastic waste. 14.5 Percent of plastic waste dominates garbage in rivers and soil, meaning every day 150 tons of garbage dumped to the ground and river. The plastic waste can not be broken down by microorganisms, consequently we are constantly in need of areas for waste disposal. Although not toxic, plastic waste can cause soil contamination, in addition to damaging the scene. Plastic is one of the world's environmental problems, especially in Indonesia due to the properties of plastics that are difficult to unravel. According to statistics on waste in Indonesia Deputy Pollution Control Ministry of Environment (MOE) in 2008, said that based on an estimate of 26 metropolitan cities with a total population of 40.1 million people generate 14.1 million tons of waste. Plastic waste reached 14% or 5.4 million tons per year and ranks second only to kitchen waste / organic .

Various efforts and innovations reducing the impact of plastic waste has been carried out. In addition to recycling plastic, environmentally friendly plastics have also been developed. Plastic made from synthetic chemicals are lightweight, strong, elastic and not easily decomposed replaced with biodegradable raw materials by the parser, called Biodegradable plastic.

The main ingredient manufacture Biodegradable plastic is starch. Starch is used as a material that can be easily degraded by nature into compounds that are environmentally friendly. Starch is a polymer type that is naturally produced by plants types of tubers, maize, and rice (generally, the starch found in plants that contain lots of carbohydrates) in the form of fine grains . One of the innovations in the manufacture of biodegradable plastic is to utilize cassava starch derived from rubber. Rubber Cassava is one of the varieties of cassava starch source which has a huge potential used as raw material for making plastics biodegradable. Besides cassava rubber is one kind of cassava tree containing toxic compounds are not traded and HCNm so underused by the public Risky Aryani (2014) have examined the manufacture of biodegradable plastics from starch cassava rubber.

Based on these studies, it is necessary to further study regarding the composition of the addition of plasticizers and chitosan. The addition of plasticizer aims to improve the mechanical properties of biodegradable plastics. In addition to plasticizer, the manufacture of biodegradable plastics need to be added as a biopolymer chitosan that is useful to improve

the mechanical properties as chitosan can form hydrogen bonds between chains with amylose and amylopectin

II. RESEARCH METHOD

A. Place and Time

The method used in this research is experimental method. Data collection using observation method. The study was conducted for approximately one month from March 14th, 2016 to April 14th, 2016, and was conducted in the Operation Unit Laboratory State Polytechnic of Sriwijaya.

B. Tools and Material

- Tools

1. Knife
2. Hot Plate
3. Tool of grated coconut
4. Filter
5. Beaker Glass 100 ml
6. Measuring glass 100 ml
7. measuring Pipette 10 ml
8. Rubber ball
9. Thermometer
10. Magnetic stirrer
11. Spatula
12. analytical balance
13. Mortar
14. Glass Plate
15. Stirrer
16. Elongation test tools

- Material

1. Cassava Rubber
2. Sorbitol
3. Glycerol
4. Chitosan
5. Acetic Acid
6. Aquadest

C. Treatment and Research Design

Research of Making biodegradable plastic is preceded by the making of starch from cassava ruber. Stages in making starch cassava rubber are washing, stripping, slicing, smoothing, drying, and filtering. After that making of biodegradable by using Starch cassava rubber and added plasticizer sorbitol , glycerol and chitosan with certain variations. Plastic printing is done by plastic molding on top of the glass mold then dried at room temperature, then analyzed.

D. Preliminary Research

This preliminary study was conducted to obtain the main research objectives, namely to get the starch cassava rubber that will be used for the main research is the making of biodegradable plastic.

E. Main Research

The main research was conducted to determine the absorbent optimum composition. Sorbitol, glycerol and chitosan in the making of biodegradable plastic from cassava rubber starch. Stage of research that will be done affixed chart shown in picture below.

F. Experiment Procedure

Making of rubber cassava Starch

1. Soaked cassava rubber in air for 1-2 days
2. Shredded rubber cassava by using grated coconut
3. Looking cassava rubber that has been shredded for separation of cassava rubber dregs and Cassava rubber starch.
4. Prepared cassava rubber starch has been obtained
5. Dryed for 1-2 days in the sun
6. Sieve for the size of a smooth size
7. Gotten cassava rubber starch is smooth and white colored

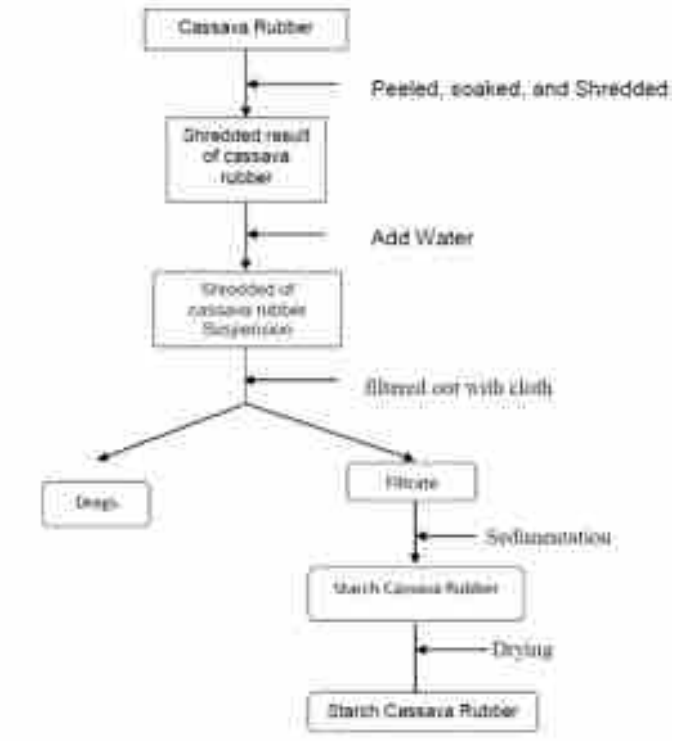

Figure 1. Flow Chart Making of Starch Cassava Rubber

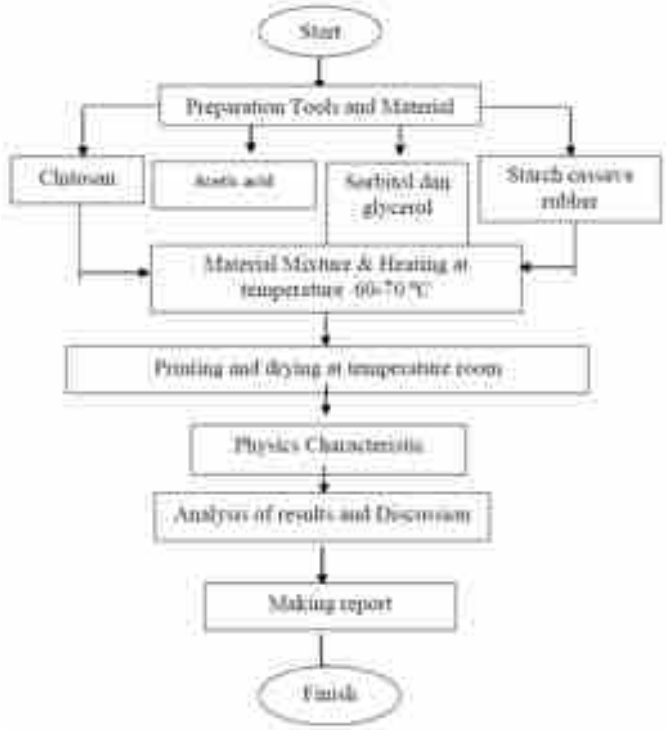

Figure 2 Flow chart of Making of Biodegradable

G. Making of Biodegradable Plastic

1. Weighed 5 grams of cassava rubber starch
2. Weighed chitosan with variation of composition 50%, 25%, 20%, 15% from starch weight
3. Prepared Plasticizer (Sorbitol and Glycerol) with variations of composition of 50%, 25%, 20%, 15% by weight of starch
4. Chitosan chitosan by using Acetic Acid 1 ml
5. Mixed all ingredients that have been prepared into the beaker
6. Heated and stirred all mixture above the hot plate at 70oC at 200 rpm until gelatination occurs
7. Poured a diluted solution on a glass mold
8. Flatten the diluted solution using a ruler
9. Silenced plastic that has been printed at room temperature for 2-3 days until drying
10. Obtained biodegradable plastic from cassava rubber starch in rectangular shape according to the size of the glass mold

H. Biodegradable Plastic Analysis

The main ingredient in this study are rubber and cassava starch plus supporting material, namely sorbitol, glycerol as plasticizer and chitosan composition v ariation of 50% by weight starch. The manufacture of biodegradable plastics is done in three stages. The first stage is to make cassava starch rubber, where the rubber before made cassava starch is soaked in water for 1-2 days which aims to eliminate the levels of HCN.

The second stage of the manufacture of biodegradable plastics is done using blending methods by mixing all the ingredients together and heated to a temperature of 75oC or occur gelatinization after that the solution has gelatinization was poured on a glass plate to be printed. The last stage is the analysis of physical properties of biodegradable plastics where physical properties are analyzed, tensile strength, elongation test, and the biodegradation test.

- *Tensile Strength*

Pull test mechanical properties are closely related to the chemical structure of the plastic biodegradable. Tensile strength shows the maximum force required to break the plastic. These properties depend on the type of plastic material maker that influence the properties of biodegradable plastics structural cohesion.

- *Test Percent Elongation*

Elongation is the process of changing the maximum length at the time of stretching to biodegradable plastic samples disconnected.

- *Biodegradation Test*

Biodegradation test aims to determine how long the sample is degraded. Biodegradation is defined as the ability of the material to be easily degraded by microbes. The process of degradation occurs, releasing carbon dioxide and water in nature. According Subowo (2013), the technique of soil burial test is one test biodegradation by soil microorganisms as an auxiliary control degradation processes .

III. RESULT

A. Bioplastics Result

Figure 3 Bioplastics produced a sheet of thin and transparent

Table 1 Tensile Test Results Analysis & Percent Elongation

Number of Sample	Plasticizer Variation (%)			Tensile Strength (Mpa)	Percent Elongation (%)
	Sorbitol	Glycerol	Chitosan		
1	25	25	0	0,00204	1,000
2	25	0	25	0,00688	0,500
3	0	25	25	0,00271	0,500
4	20	15	15	0,00490	1,000
5	15	20	15	0,00489	2,000
6	15	15	20	0,00729	0,500
7	50	0	0	0,00204	2,000
8	0	50	0	0,00294	1,000
9	0	5	50	0,00980	0,100

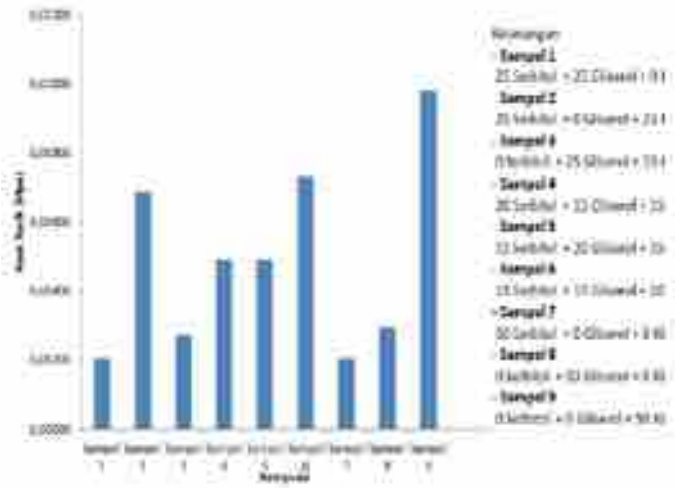

Figure 4 Graph tensile test

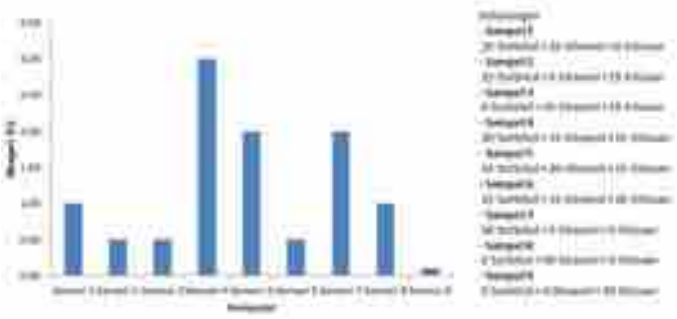

Figure 5 Graphic Test Elongation Percent

IV. DISCUSSION

A. Bioplastics Result

Figure 3.1 is a biodegradable plastic products produced, in the form of thin sheets, and transparent, biodegradable plastics in addition to chitosan more properties rigid and hard plastic, while plastic has plasticizer composition that has many properties of elastic and thin.

Figure 3 .1 Bioplastics produced a sheet of thin and transparent

Table 1.1 Tensile Test Results Analysis & Percent Elongation

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4	20	15	15	0,00490	1,000
5	15	20	15	0,00489	2,000
6	15	15	20	0,00729	0,500
7	50	0	0	0,00204	2,000
8	0	50	0	0,00294	1,000
9	0	5	50	0,00980	0,100

B. Tensile Strength test

The first analysis is an analysis of tensile strength, this test aims to determine the resistance of a material to loading at the point of bending and also to determine the elasticity of a material [7] Figure 2 shows that the more the chitosan composition of the tensile strength will be even greater. This is seen in the sample with a composition of 15% sorbitol, 15% glycerol, and 20% chitosan as well as samples with composition 0% sorbitol, 0% glycerol, and 50% chitosan. Where the chitosan composition is more dominant than the plasticizer effect of chitosan greater tensile strength greater cause This is due to the addition of chitosan increases the density of the alloy so that the structure of
the resulting polymer increases and difficult to cut off [8].

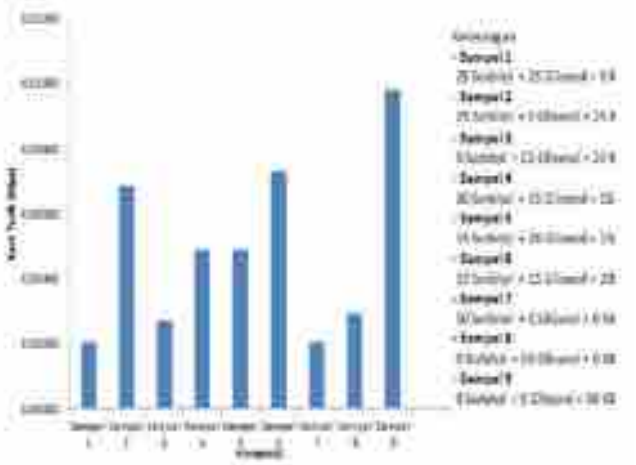

Figure 4.1 Graph tensile test

Composition of chitosan and the plasticizer also affect the physical properties of the biodegradable plastic. According Krochta (1997), higher concentrations of the chitosan produced plastic structure more rigid and hard, causing the value of the resulting high tensile strength. [9].

When compared with the standard international plastics (ASTM5336) in (Utomo, 2013) the magnitude of the tensile strength of PLA plastic from Japan reached 2050 MPa and plastic PCL of England reached 190 Mpa. According Darni and Herti (2010) the amount of tensile strength of the plastic by Indonesian national standard is 2.47 to 302 MPa. While the magnitude of bioplastics
produced tensile strength of this study was 0.00980 MPa, where great tensile strength are not in accordance with the standards used by the plastic PCL of UK and Japanese standard of PLA plastics and plastic SNI. This is because since the products produced are not entirely of plastic, but rather a new, plastic.

The test results also show the same thing to the research conducted by Nurfajrin, Z (2015), the research conducted is the manufacture of edible film of starch banana peel with the addition of chitosan and glycerol as a plasticizer. Tensile strength values in glycerol 2 ml, 4 ml, and 6 ml respectively amounted to 23.78 kg / cm2, 34.78 kg / cm2, 37.45 kg / cm2. more plasticizer added, the tensile strength will be reduced.

C. Percent Elongation Test

Percent Elongation is the mechanical properties are closely related to the physical properties of biodegradable plastics. Elongation or elongation is the maximum length change during a stretch until the sample is disconnected. In Figure 5.1, the result is the addition of sorbitol directly proportional to the percent elongation that means the greater the concentration of sorbitol the more percent elongation.

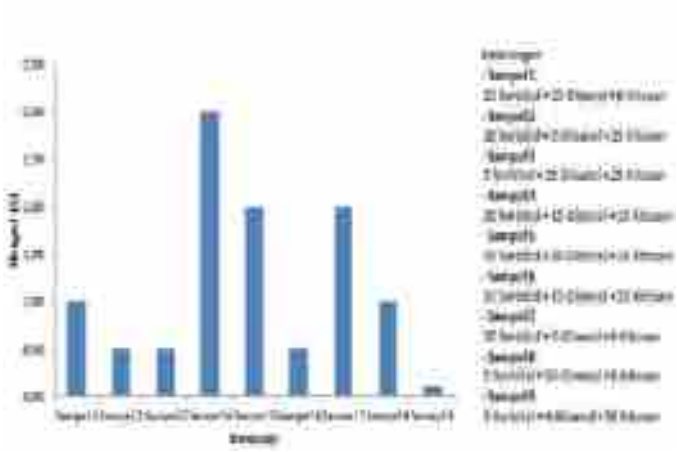

Figure 5.1 Graphic Test Elongation Percent

THE OPTIMUM CONDITIONS FOUND IN 4 SAMPLES (20% SORBITOL, 15% GLYCEROL, 15% CHITOSAN) AND PERCENT ELONGATION OF BETWEEN 3% AND MINIMUM CONDITIONS CONTAINED IN THE SAMPLE 9 (0% SORBITOL, 0% GLYCEROL, 50% CHITOSAN) THAT THE ELONGATION OF ONLY 0 , 10%. WHEN COMPARED WITH THE STANDARD INTERNATIONAL PLASTICS (ASTM 5336) THE PERCENTAGE OF ELONGATION (ELONGATION) FOR PLASTICS PLA FROM JAPAN REACHED 9% AND PLASTICS PCL OF UK REACHED MORE THAN 500%, ACCORDING DARNI AND HERTI (2010) MAGNITUDE% ELONGATION BASED ON NATIONAL STANDARDS OF INDONESIA IS 21 - 220%. THE AMOUNT OF ELONGATION BIOPLASTICS PRODUCED FROM THIS RESEARCH HAS NOT BEEN IN ACCORDANCE WITH THE STANDARDS USED BY PCL OF THE UK PLASTICS AND PLASTIC PLA STANDARD OF JAPAN, AS WELL AS THE NATIONAL PLASTIC STANDARD (SNI).

THE ADDITION OF PLASTICIZER ABLE TO REDUCE BRITTLENESS AND INCREASE THE FLEXIBILITY OF THE POLYMER FILM BY MEANS OF DISRUPTING HYDROGEN BONDS BETWEEN ADJACENT POLYMER MOLECULES SO THAT THE TENSILE STRENGTH OF THE INTERMOLECULAR ATTRACTIVE POLYMER CHAINS TO BE REDUCED AS A RESULT OF THE ADDITION OF PLASTICIZERS.

D. Biodegradation test

Biodegradation test was conducted to determine the sample time bioplastics to degrade. Biodegradibility process can occur with soil burial test technique where by controlling soil microorganisms maid degradation process. The process of biodegradation test analysis was carried out for less than 60 days, the tested plastic cut to size 2cm x 2cm. This test is conducted on each sample in soil media and water media. In the soil media, plastic planted in the ground for 60 days, in the sample biodegradable plastics have decomposed completely because the intensity of the microbes in the soil is very much.

While in aqueous media, placed inside plastic containers have water contains different media that is using rain water, well water, waste water, distilled water, and water taps. During the 60 days most of the plastic has been degraded completely. the waste water completely degradable plastic is faster than other media due to the intensity of the water which microbes in the waste water is high enough. in some samples biodegradable plastics have not seen shriveled and in some parts there is a cracked and overgrown mushroom samples, and also changes the color of the water becomes murky and slimy.

According to international standard (ASTM 5336) the length of degradable plastic films for PLA plastic from Japan and PCL from the UK will need 60 days to decompose as a whole (100%) (Coniwanti P, 2014). The length of degraded resulting from this research are less than 60 days to decompose almost all (85%). This proves that our results meet the criteria for the degradation of plastic film. Based on the composition of the plasticizer and chitosan, chitosan composition of the
plastic has more, relatively longer be decomposed due to chitosan as a preservative, either Chitosan is used as an additive in the manufacture of plastic because it has properties micro anti bactery (Dutta et al., 2009).

V. CONCLUSION

From the research that has been done can be concluded that:

1. Plastic Products from starch cassava rubber is type biodegradable can decompose by good microorganism on soil media and water media.
2. In the tensile strength test obtained best result on samples without plasticizer (0% sorbitol , 0% glycerol , 50 % chitosan) is 0,00980 MPa, while the elongation test obtained best result in the sample , plasticizer dominant is 20 % sorbitol , 15% glycerol , 15% chitosan with percent elongation is 3 % .
3. Biodegradable plastics produced based on the value of tensile strength test , the physical properties is rigid and hard , while based on the value percent elongation , the physical of biodegradable plastics is more elastics. Based biodegradation test , biodegradable plastics produced have the physical properties can decompose completely in less than 60 days on soil and water media and biodegradable plastics can not be applied as a food packaging because it is still very fragile and so fast moldy.
4. The biodegradable plastic is one solution to plastic waste problem of environmental pollution. Plastic Biodegradable is a natural polymer that is easily decomposed by microorganisms and Biodegradable plastic can be answered one of environment problem in palembang city about plastic waste.

CONFLICT OF INTEREST

Effect of Plasticizer and Chitosan composition on the Quality of Plastic Biodegradable from starch Cassava rubber (Manihot Glaziovii) As Alternative Plastic certify that the findings Paper writing that we create is purely the result of the findings of the work of Our Own (Not plagiarism).

ACKNOWLEDGEMENTS

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